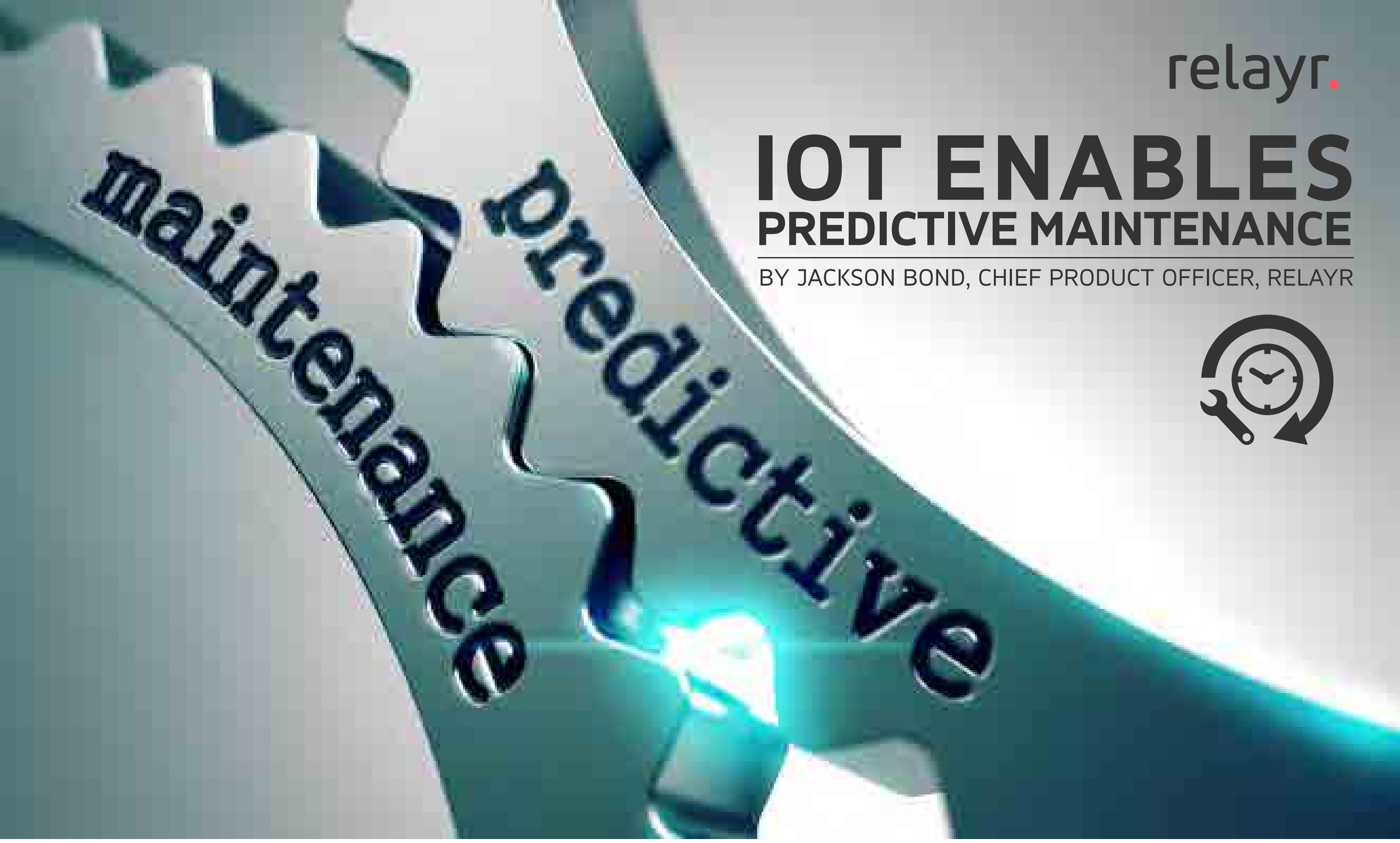

relayr.

IOT ENABLES PREDICTIVE MAINTENANCE

BY JACKSON BOND, CHIEF PRODUCT OFFICER, RELAYR

If you think about manufacturing, your mind probably creates images of lots of machines operating automatically in a relatively clean, tidy and sometimes noisy environment. In a world that is heavily dependent on technology to operate machinery and keep a manufacturing process running, the scene certainly looks very different from that of a generation ago.

Introduction

Over the past ten years or so there have been many smart manufacturing initiatives that have promoted the need for production facilities to become much more efficient and effective through the use of technology. Initiatives such as Industry 4.0, initially conceived by the German government, have been adopted by other nations as a template for how process and production-based organizations can improve their overall productivity and efficiency. More recently, the concept of the connected factory, as achieved through the Industrial Internet of Things (IIoT), is significantly driving up operational effectiveness, resource utilization and a digital visibility of production and process metrics never before thought possible.

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While examining the physical manner in which a production line or discrete process line can be made more efficient, it is highly likely the machinery that makes it operate is still reliant on a variety of motors, sensors, actuators, process controllers and valves. With increased efficiencies the impact of any equipment failure or unplanned downtime can significantly affect plant operations. However, the concepts of maintain, repair and operate (MRO) are well-rooted in any manufacturing organization, so management will already be very familiar with the steps needed to address such operational challenges. Planned maintenance of machinery and equipment is still a common process at many manufacturing sites, although the pressures of business agility, process flexibility and keeping downtime costs to a minimum are now demanding a change to this approach. Closely monitoring critical production machinery/assets is essential to maintain the reliable and smooth running of a manufacturing process.

Smart Factory

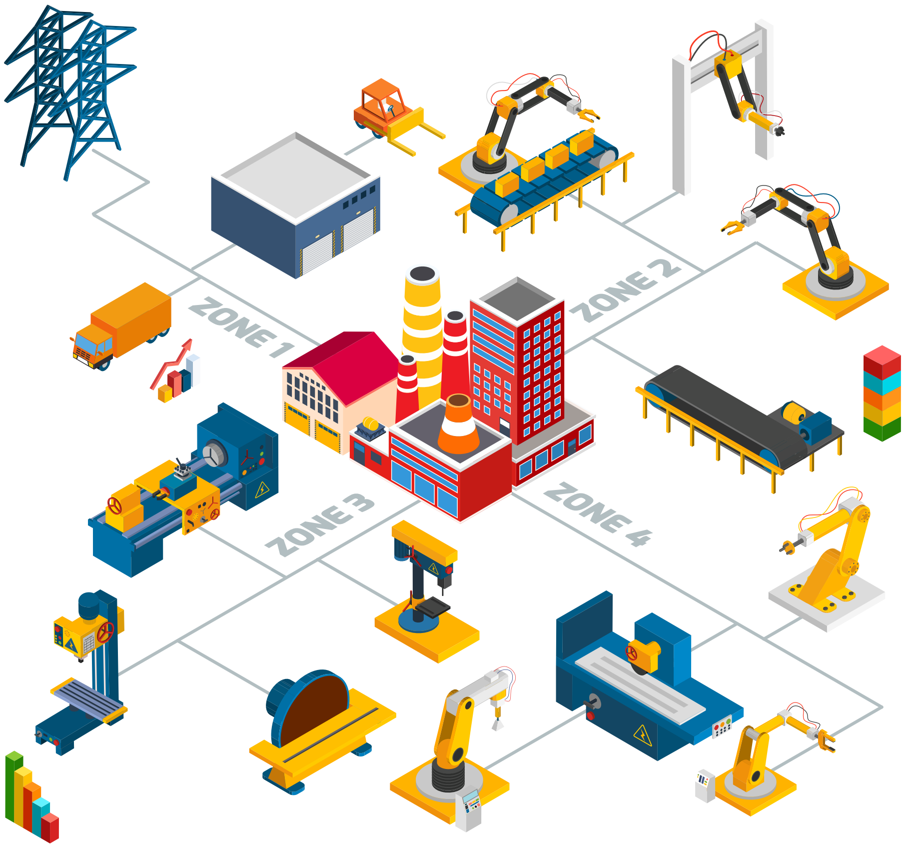

Fig. 1 illustrates the basic concepts of a smart factory. Connecting together all the individual parts of a production line will enable a more holistic view of how the facility is operating.

Comparing how each stage of the production or assembly process is performing helps establish baseline metrics and highlights bottlenecks in a process that might slow down subsequent operations or limit the throughput of activities leading up to that stage. However, the holistic viewpoint of the smart factory also extends to individual items such as motors and the other parts identified above, which make the production machinery operate. With the exception of perhaps some passive sensors that measure, for example, temperature or humidity, the vast majority of items will consist of moving and wearable parts like bearings, brushes, linkage arms, seals and gaskets. Each has its own operating life and sometimes involves the complexity of, for instance, a motor that has multiple bearings and seals, all of which wear at different rates that are often dependent on frequency of use, operating pressures and running hours. In short, each component of any piece of production machinery will potentially have a number of different maintenance regimes associated with it.

Maintaining the production assets

Responsibility for implementing the most efficient maintenance cycle across a production facility or manufacturing site often falls to the engineering manager and their team of multidisciplinary service engineers. As already highlighted, the need to maintain production assets is well-established and there are several methods of approaching this task. There are many techniques and methods utilized for regular maintenance, including (but not limited to) corrective, preventative, and condition-based maintenance. Predictive maintenance, for example, uses past repair and service history, together with usage and different sensors (e.g., monitoring vibration) to predict when a part might fall below optimal operating efficiency. Having this data enables scheduling a service or part replacement ahead of failure.

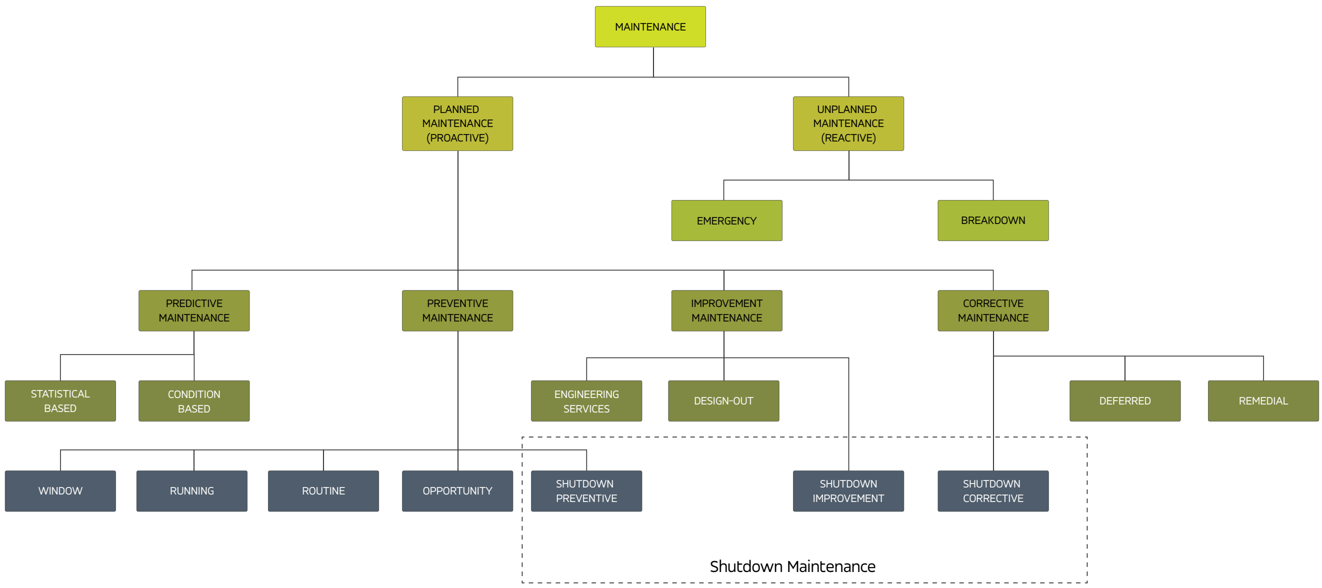

Figure 2. Maintenance types

At the other extreme, a corrective or reactive maintenance approach simply requires a part to be replaced once it fails. While probably the most straight-forward approach to maintenance, this might mean that in a flow production process the whole manufacturing line would need to shut down while a repair is made. Of course, any maintenance approach might require a line shutting down although, in reality, this might just be one part of a production cell and, when planned, another machine could take up the task without impacting the whole production process. Another approach to maintenance is based around a hydraulic actuator manufacturer's recommended approach to sampling the oil for analysis every 250 hours of machine use. However, such a preventative approach, along with other established maintenance best practices, can involve planned downtime and engineering resources that have an impact on operational efficiency without any guarantee they are necessary.

For example, two industrial robots are maintained at the same time rather than just the one that really needs it because the consequence of maintaining only one can significantly reduce the manpower cost per machine. Some machines are thus maintained even if they are not in need of maintenance, because it’s perceived to be cheaper to get them both inspected at the same time.

Predictive maintenance; making it happen

Most engineering maintenance teams recognize the holy grail of maintenance is total productive maintenance (TPM). A system of maintaining and improving the integrity of production through the machines, equipment and processes that adds demonstrable business value is best served by a predictive maintenance approach and that requires data – lots of it.

A truly predictive system relies on an informed approach for each production asset. Data is gathered and analyzed in real-time, from multiple connected sources (e.g. temperature and vibration sensors) to predict when a failure might occur. Analysis systems and associated algorithms process the data, looking for minor anomalies and potential failure patterns in each and every asset comprising the entire production capability of a site.

Fig. 3 Connecting a large number of sensors across the manufacturing facility is precisely what the IIoT is about.

Harvesting the data generated by IIoT-enabled machinery is a step in the process towards implementing TPM. How does the data get to the analysis and algorithm systems? How can dashboards be quickly created to highlight plant management and increase overall equipment effectiveness (OEE) through continuous improvement?

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relayr Smart Manufacturing solution

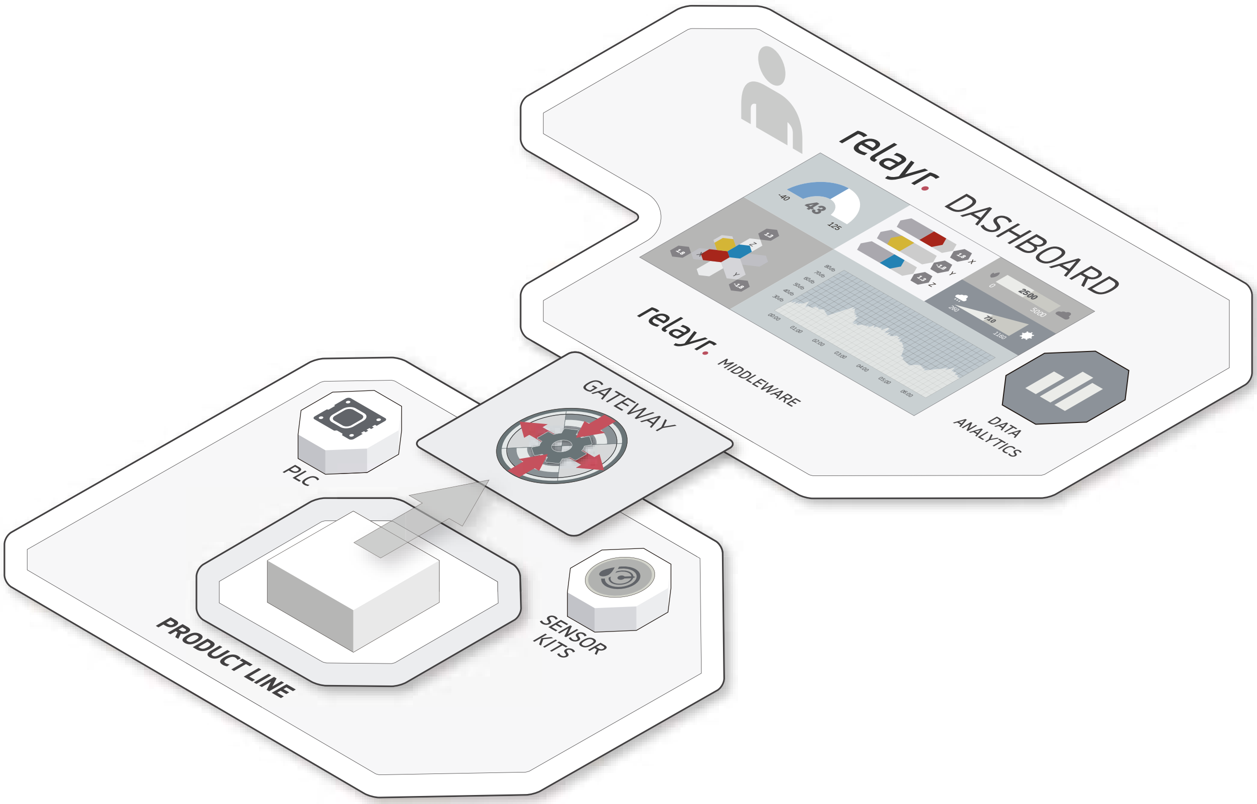

Fig. 4 relayr OEE platform

The relayr Smart Manufacturing solution aims to improve OEE by providing the key building blocks of IIoT and manufacturing, from the edge sensors to the cloud and back again.

All functionalities come with a user-friendly interface based on a widget architecture. It's designed to visualize all the data gathered from a vibration sensor (or other industry-specific sensors) attached to an industrial robot's base rotation bearing. This approach could be extended to show all the vibration and temperature readings collected from every arm and rotational joint of the robot. Customized dashboards could be created to show the aggregated data for all robots across the factory floor, with an historical analysis that might, over time, show gradual bearing wear that would complement the predictive maintenance analysis for a particular robot model.

An important part of relayr's Smart Manufacturing solution is managing the data, which includes: data processing, data transfer, and control of the data generated by the IIoT-enabled assets.. It handles the aspects of streaming the data communication via subscription services such as MQTT or WebSockets. Additionally, users can use the data to undertake rules-based actions. Such actions might include aggregating data to establish an average, measurement count, or minimums and maximums in addition to specific rules that calculate OEE metrics. For predictive maintenance purposes relayr's Smart Manufacturing solution can also take care of invoking and interaction with analysis-based neural networks algorithms.

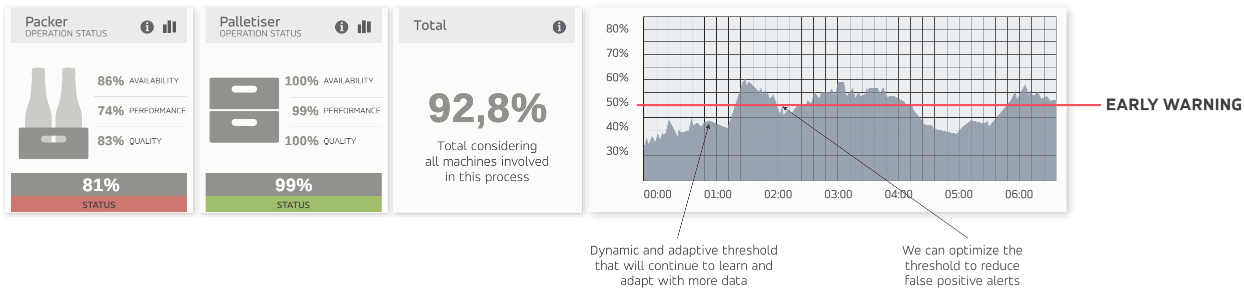

Fig. 5 Predictive Maintenance dashboard

Relayr's gateway software serves to provision edge-sensor, node-to-cloud connectivity in addition to local cloud support. A key aspect of this task is ability to support all the key industrial process protocols such as Modbus, Siemens S7, and OPC-UA, and the IIoT/IoT standards of CoAP and MQTT. relayr's gateway and end node software aids network security monitoring by enabling data collection from multiple devices and transferring it to the cloud through a single outgoing connection.. Also, through the use of APIs, we can provide delegated autonomy from cloud applications for straightforward tasks through the use of rules – for example, turning on a fan when a sensor reports a temperature limit has been reached. This feature is particularly useful where communication latency or reliability of connection makes the cloud unreliable.

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Summary

The Industrial Internet of Things (IIoT) significantly aids the move towards a predictive maintenance approach. The army of connected sensors, monitoring every aspect of manufacturing from the production process to the associated machinery, provides real-time insights into a site's operational effectiveness and equipment condition. asking the most from the IIoT relies on using a cloud infrastructure that not only provides the basic platform approach but also has the software services and tools to facilitate implementing a predictive maintenance process. relayr's Smart Manufacturing solution has everything you need to create a flexible, reliable, and scalable platform from which to build your predictive maintenance capabilities.